Space Weather Technical Forecast

Issued on Wednesday 30 October 2024 at 01:06 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Isolated M-flares expected, with slight chance of X-class flares. S1 Minor Storm easing.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Moderate with peak flare M1.1 at 29/1633 UTC from AR3869, however this occurred alongside a very long duration C-class flare due to a broad prominence and filament eruption off the southwest disc. There are ten sunspot regions on the disc. The most likely flare source is AR3878 in the northeast, with a delta spot on its trailer. Some decay was apparent in the south-centre disc sunspots AR3869/AR3872/AR3873 however these continued to have a relatively complex appearance in SDO-aia imagery, with AR3869 reassessed to now include the previous trailer of AR3872. Development was observed in AR3876 to the northwest of these regions, with smaller spots emerging and coalescing into larger ones, along with the region containing a weak delta spot. The other regions remain smaller or simpler.

Coronagraph imagery was limited during this period, however it is likely that the broad filament eruption was directed south and west, ahead of and off the Earth-Sun line. No other Earth-directed CMEs were observed.

Solar Wind / Geomagnetic Activity: Ongoing fast winds from CH85 were observed. Solar wind speeds, observed by ACE at L1, were slightly elevated between 450-500 km/s. Density was around or below average. Interplanetary Magnetic Field (IMF), Bt, was weak around 5-8nT, with north-south component, Bz, varying weakly but favouring a negative (southward) orientation from 29/1800 UTC. Phi angle remained negative (towards the Sun). Resulting geomagnetic activity was Quiet (Kp2-3) with one Active interval (Kp4) 29/1800-2100 UTC.

Energetic Particles / Solar Radiation: High energy proton flux observed by GOES18 was at at S2 Moderate Radiation Storm, at 227 pfu at 29/0000 UTC, but showed a steady decline. This eased to be at S1 Minor Radiation Storm 29/1455 UTC, and continued easing to be at 71pfu at 30/0000 UTC. High energy electron flux (greater than 2MeV) observed by GOES16 was at background. The associated 24-hour fluence was well below the Active threshold, with 2.01e6 integrated flux observed at 30/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Moderate activity is expected, with isolated M-class flares. There is chance of rising to High with an isolated X-class flare.

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Solar Wind / Geomagnetic Activity: There are no CME arrivals currently expected, with current fast winds expected to ease towards background day 1-2 (30-31 Oct). Mainly Quiet geomagnetic activity is expected, with isolated Unsettled intervals and a slight chance of Active intervals early on day 1 (30 Oct).

Energetic Particles / Solar Radiation: The high energy proton flux at GOES-18 is currently at S1 Moderate Radiation Storm, but declining, and likely falling below this level in the next 24-48 hours. However, any further notable flares will bring the potential for further enhancement. The high energy electron flux is expected to be mainly Background, with the associated fluence forecast to persist below Active.

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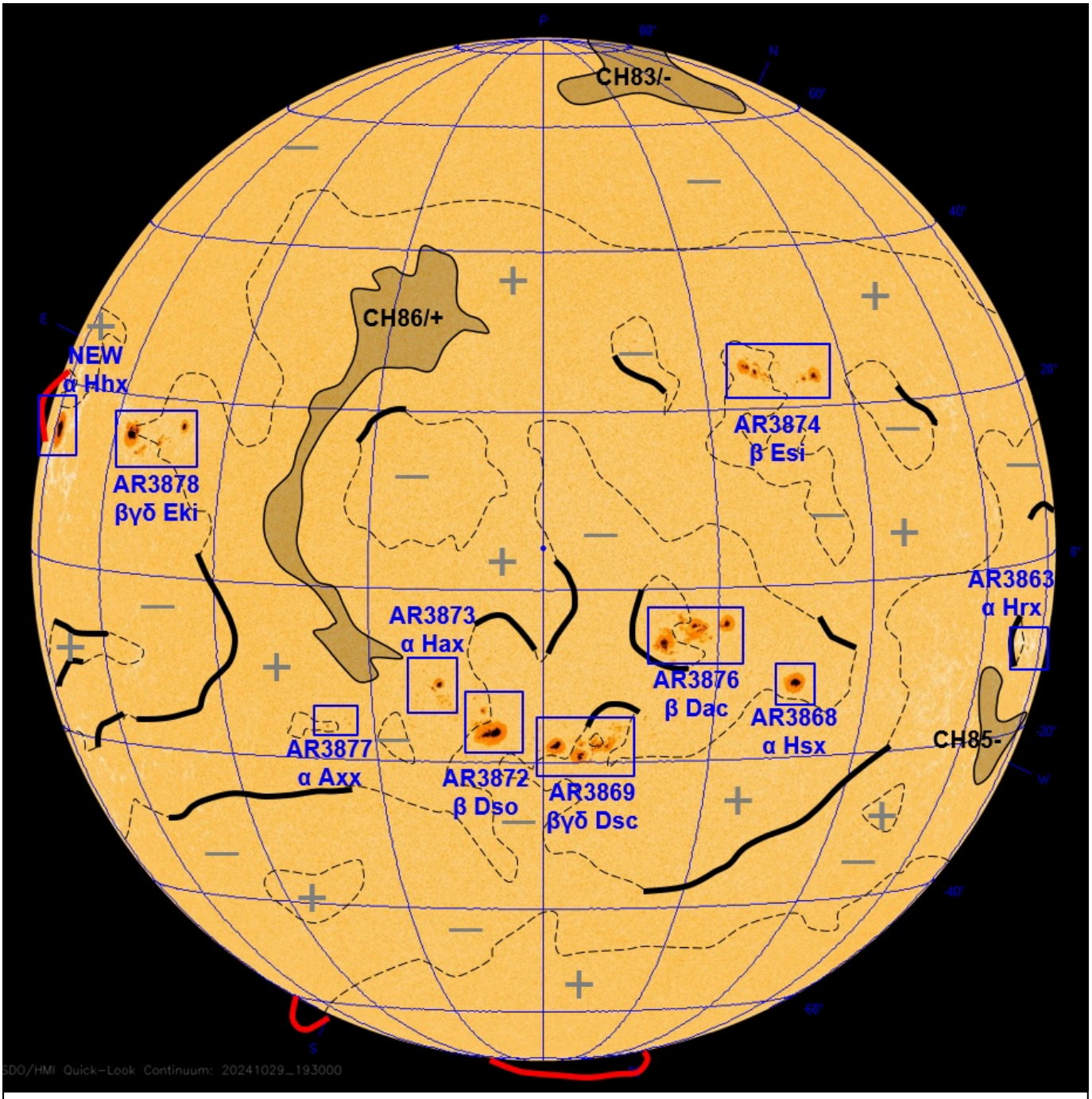
Figure 1: Solar Synoptic Map 29/2000 UTC



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms

There are currently no Earth-directed CMEs. However, given the number of filaments on the Earth-facing disc, along with the chance for notable flares, this has the potential to change at short notice.

Current fast winds associated with CH85/-, are expected to through day 1-2 (30-31 Oct) with slow wind returning and solar winds speeds easing to background. This gradual easing trend is supported by MOSWOC Enlil, although this maintains faster winds for longer than currently expected. No other enhancements are expected in the period, with the next coronal hole enhancement likely from CH86/+ which is currently in the eastern disc.

Mainly Quiet geomagnetic activity is expected, with isolated Unsettled intervals and a slight chance of Active intervals early on day 1 (30 Oct).

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	5	1	5	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

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Figure 2: MOSWOC Enlil

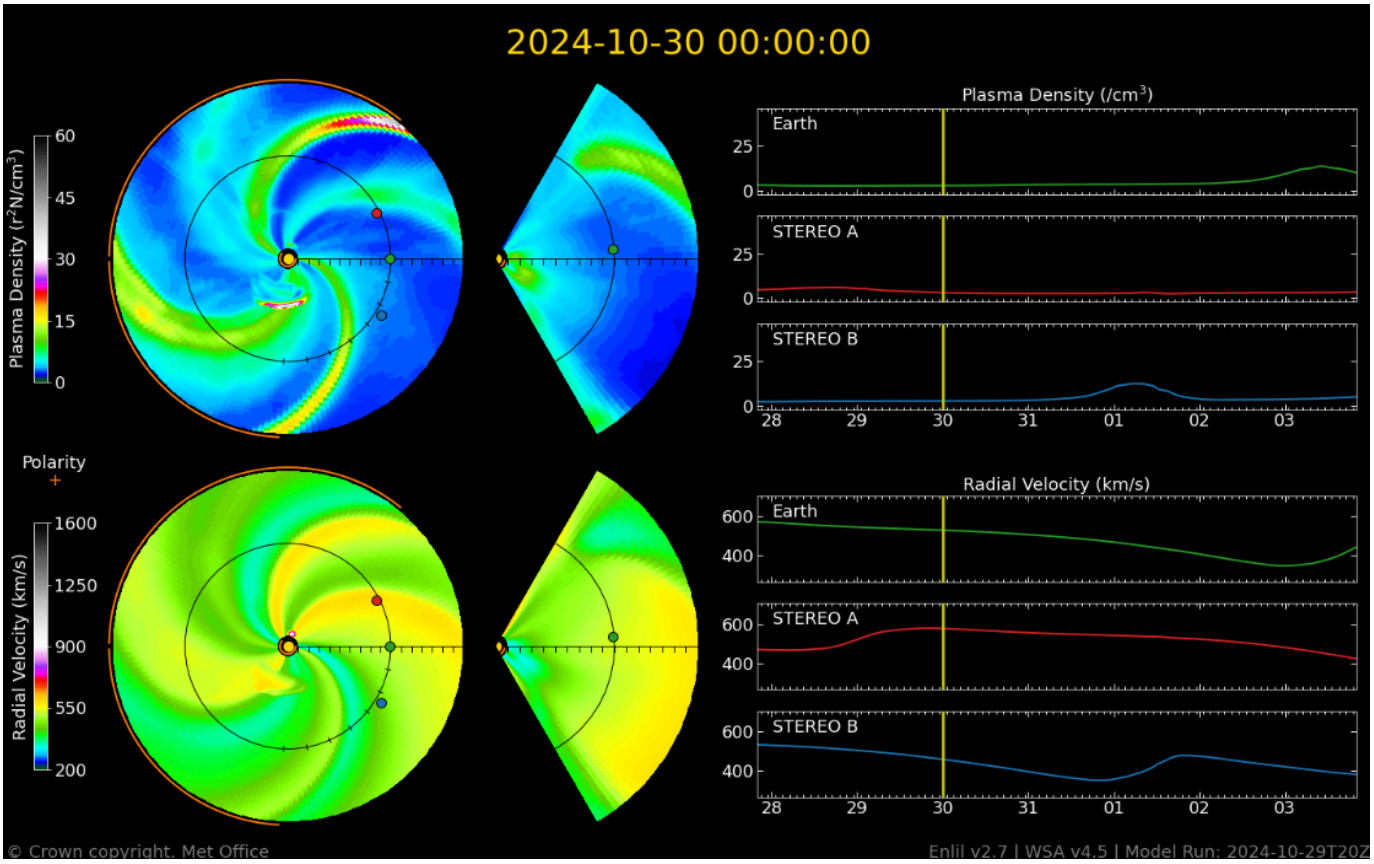
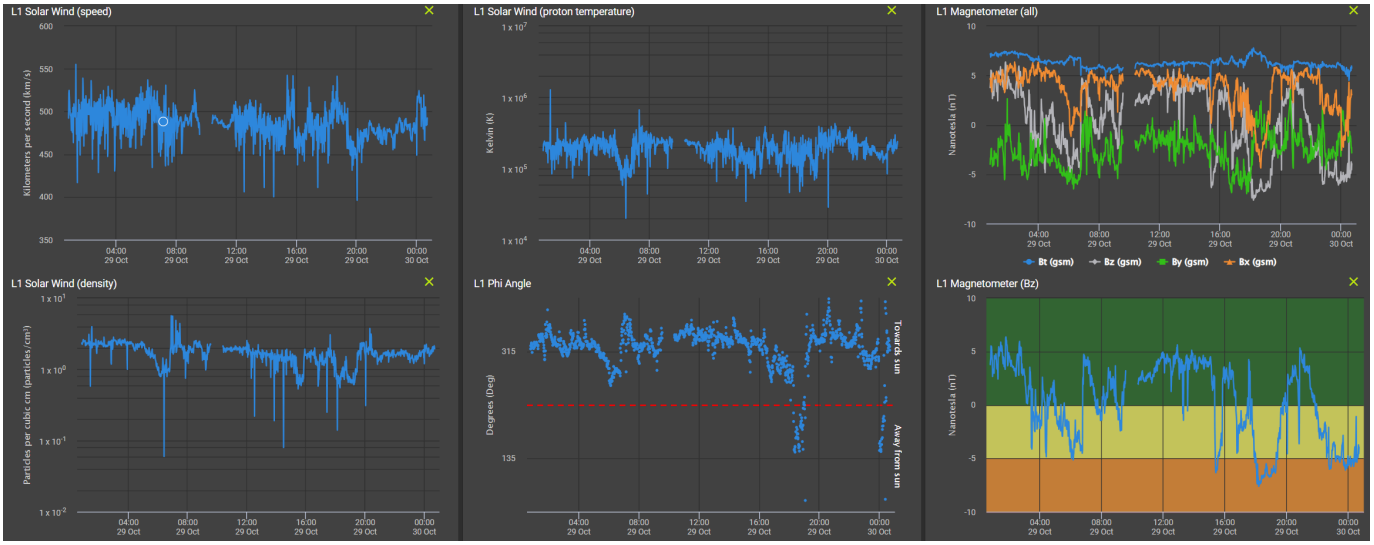


Figure 3: L1 Solar Winds (Predominately ACE)



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Radio Blackouts - X-Ray Flares

Moderate activity is expected with isolated M-class flares, but with a slight chance of becoming Strong with an isolated X-class flare. There are ten sunspot regions on the disc, and while there are no particularly complex or active regions, there are a few with the potential to produce notable flares. The most frequent M-flaring region is AR3878 in the northeast. This is a relatively small region, but has maintained a moderately strong delta spot on its trailer, and appears bright in SDO aia-imagery, suggesting further activity is likely.

The cluster of three spots in the south-centre disc have shown a general declining trend, but also provide a potential for further notable flares. The most notable of these is now AR3869, having been reanalysed to include the previous leader of AR3872, due to its proximity and apparent structure in SDO aia-imagery. This results in an anti-Hale cycle spot, with some mixed polarity amongst the small leader spots. AR3872 continues to be a bipolar region, but now a simpler north-south aligned spot, albeit with some apparent magnetic looping in SDO imagery to its north that may have a sigmoidal structure. These can suggest an increased chance for notable eruptions. Finally AR3873 is now a declining unipolar spot

Also of interest is AR3876 to the northwest of the cluster. This has seen its spots coalesce into three main larger spots, but with a small spot to the north of its intermediate showing a very weak delta configuration. AR3874 in the northwest is a simple bipolar group, while a yet to be numbered region in the northeast appears to be a large unipolar spot, but is potentially the returning region that produce the notable eruptive event on 09 Oct.

X-Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 (M Class)	Yes	75	75	75	75
Very Active	R3-R5 (X Class)	No	20	20	20	20

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Figure 4: GOES 16/18 X-ray Irradiance

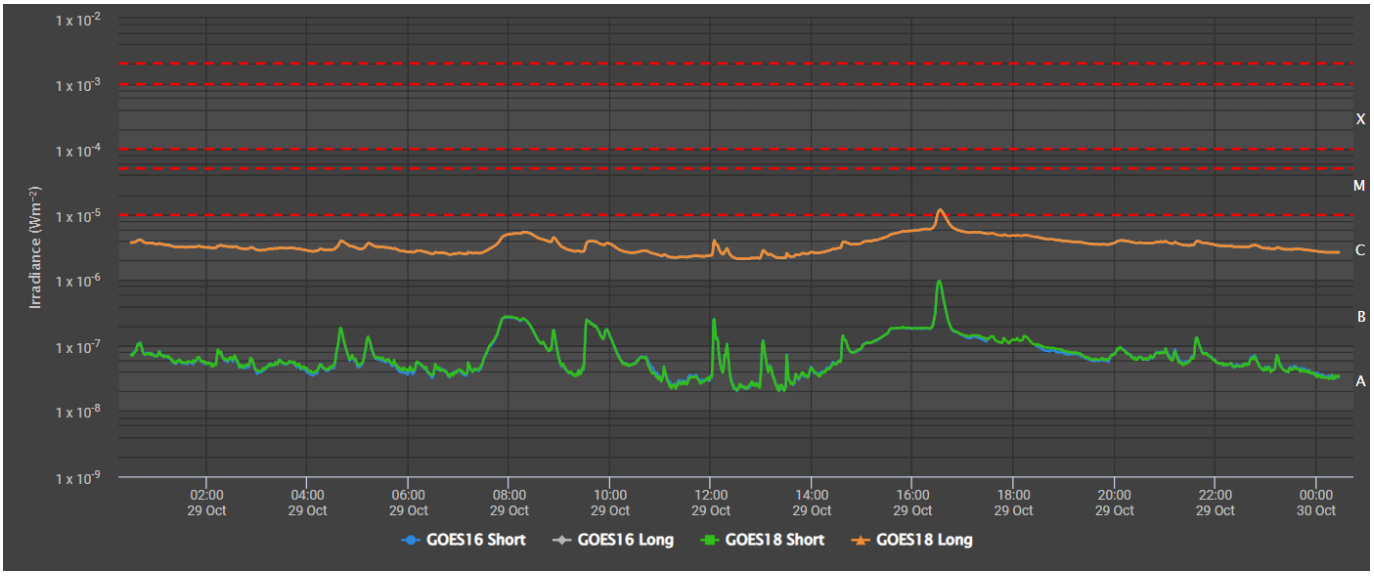

Figure 5: SDO images of southern disc sunspots (AR3873/72/69/76/68) from left to right.

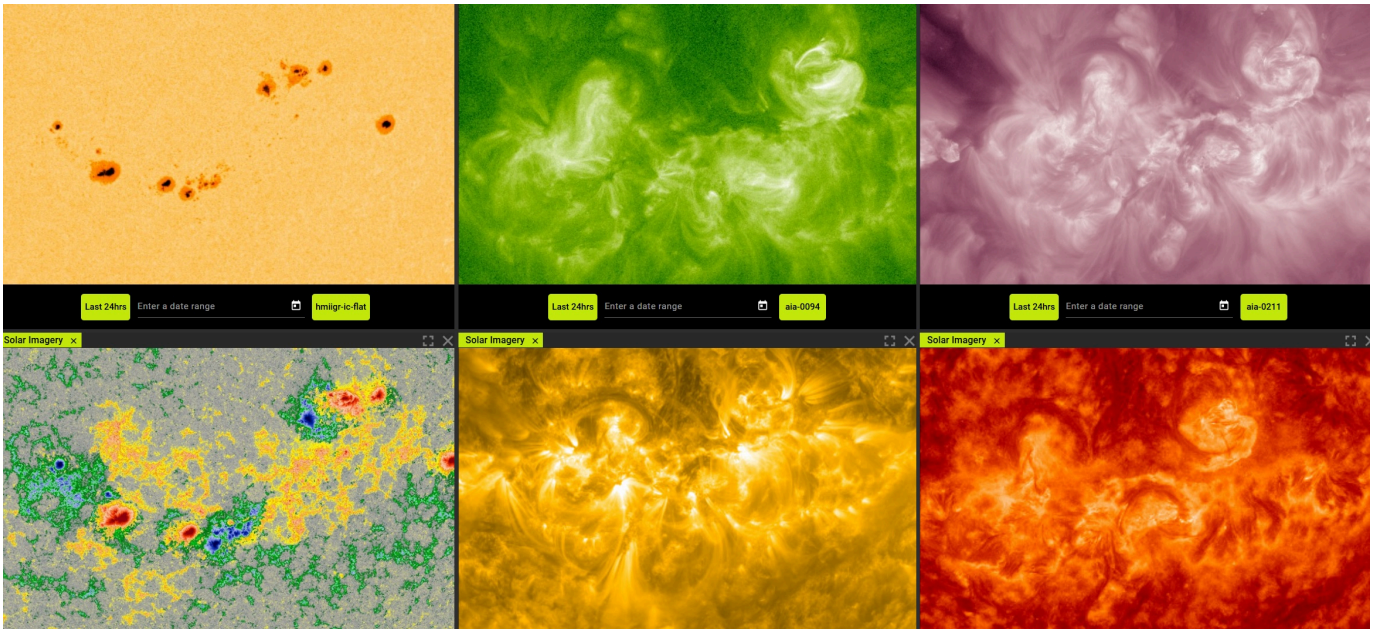

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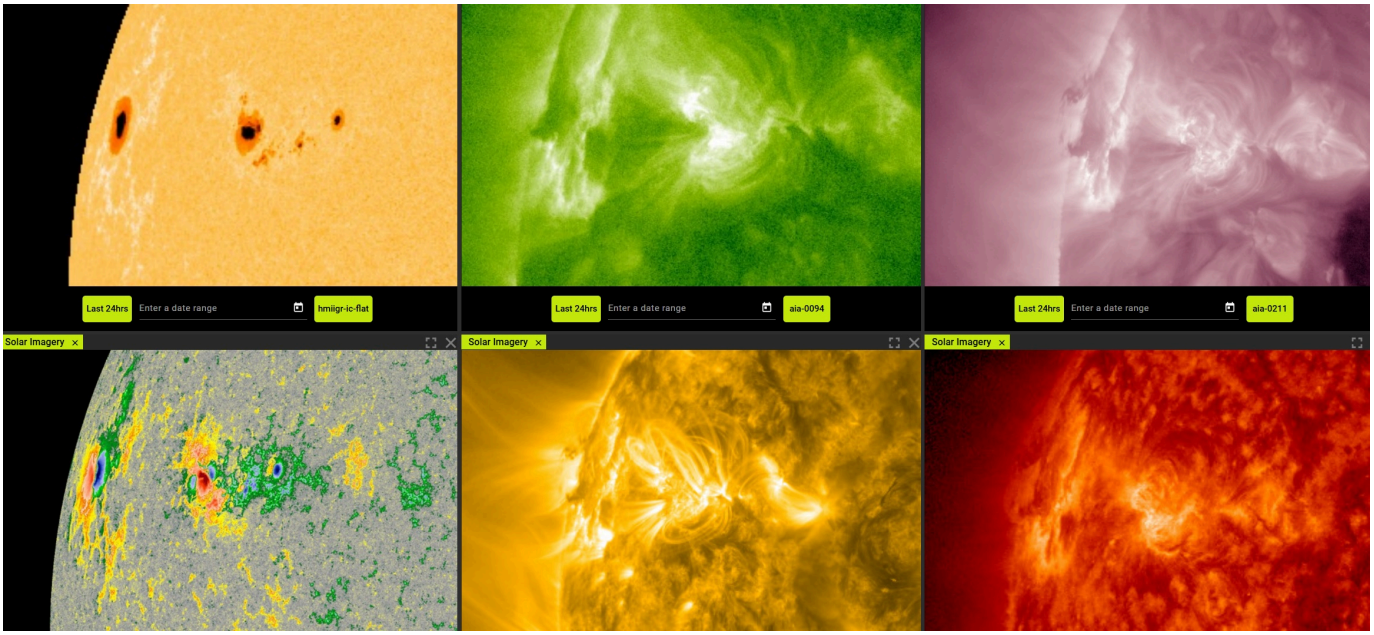
Figure 6: SDO images of northeast disc sunspots. NEW and AR3878 from left to right.



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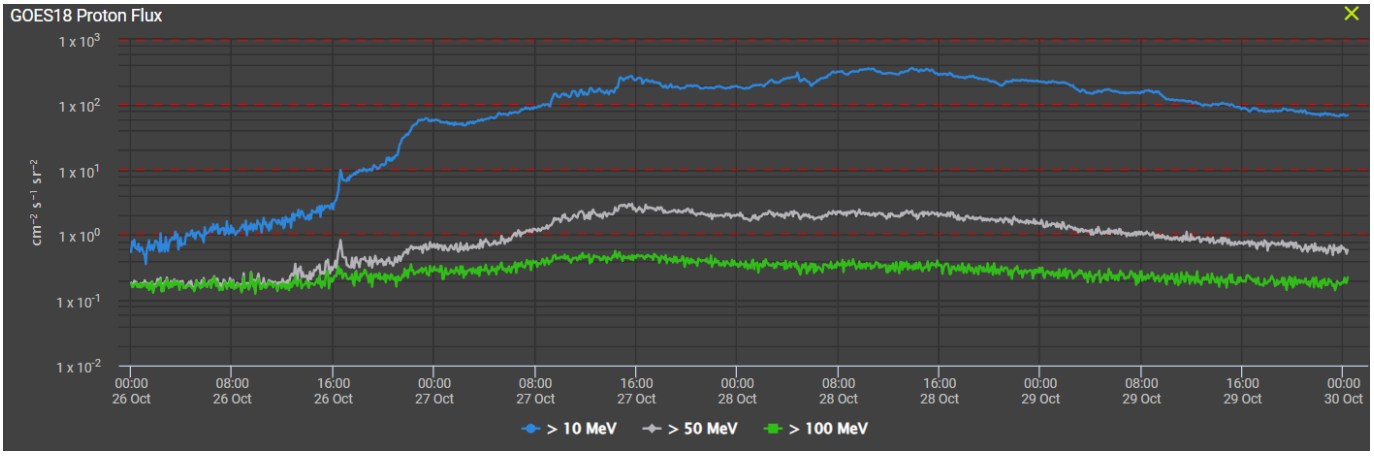
Solar Radiation Storms (High Energy Protons)

Recent CME and X-flare activity elevated the high energy proton flux at GOES-18 over the previous day, which after peaking at S2 Moderate Radiation Storm, is now easing to be at S1 Minor Radiation Storm level at time of issue. A gradual decay is now expected, likely falling below S1 during the coming 24-48 hours.

Further enhancements remain possible, with notable flares possible from a number of the sunspots on the disc. This includes the cluster of regions in the south-centre disc, plus AR3876 to the northwest of this cluster. Notable flares are also possible from AR3878 in the northeast, and while less likely produce observable protons at Earth, this cannot be ruled out.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	Yes	99	30	20	20
Very Active	**≥ S3 ***	No	5	5	5	5
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 7: GOES-18 >10 MeV, >50 MeV and >100 MeV Proton Flux since 26 Oct. Peaked on 28 Oct and has been gradually declining since.



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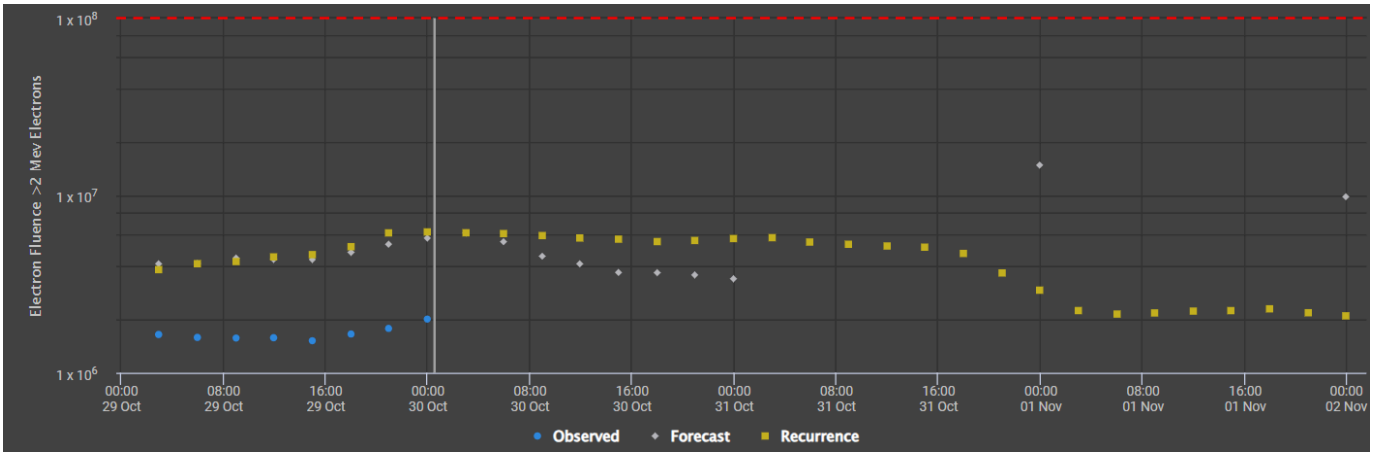
High Energy Electrons (≥ 2MeV)

High energy electron flux (greater than 2MeV) as observed by GOES16 is currently at background and expected to persist mostly at this level, with only brief spells of moderate possible.

The associated 24-hour fluence is currently expected to remain well below Active throughout the period, with the MOSWOC REFM forecast though to be providing reasonable guidance to staying below this Active level, although this is likely to over-estimate the forecast fluence due to the current elevated winds.

GEO Electron Environment	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1×10^{8}	No	1	1	1	1
Very Active	≥ 2 MeV ≥ 1×10^{9}	No	1	1	1	1

Figure 8: GOES-16 >2 MeV 24 hr Electron Fluence with REFM and Recurrence.



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